X-rays, Gamma Rays, and Cancer Risk

When talking about radiation and cancer risk, it is often x-rays and gamma rays that people think about.

What are x-rays and gamma rays?

There are many different types of radiation – from the light that comes from the sun to the heat that is constantly coming off our bodies. But when talking about radiation and cancer risk, it is often x-rays and gamma rays that people think about.

X-rays and gamma rays can come from natural sources, such as radon gas[1], radioactive elements in the earth, and cosmic rays that hit the earth from outer space.

But this type of radiation can also be man-made. X-rays and gamma rays are created in power plants for nuclear energy, and are also used in smaller amounts for medical imaging tests, cancer treatment, food irradiation, and airport security scanners.

X-rays and gamma rays are both types of high energy (high frequency) electromagnetic radiation. They are packets of energy that have no charge or mass (weight). These packets of energy are known as *photons*. Because X-rays and gamma rays have the same properties and health effects, they are grouped together in this document.

Both x-rays and gamma rays are forms of high-frequency *ionizing radiation*, which means they have enough energy to remove an electron from (ionize) an atom or molecule. Ionized molecules are unstable and quickly undergo chemical changes.

If ionizing radiation passes through a cell in the body, it can lead to mutations (changes) in the cell's DNA, the part of the cell that contains its genes (blueprints). Sometimes this causes the cell to die, but sometimes it can lead to cancer later on. The amount of damage caused in the cell is related to the dose of radiation it receives. The damage takes place in only a fraction of a second, but other changes such as the beginning of cancer may take years to develop.

Gamma rays and x-rays aren't the only kinds of ionizing radiation. Some types of ultraviolet (UV)[2] radiation are also ionizing. Ionizing radiation can also exist in particle form, such as protons, neutrons, and alpha and beta particles.

Doses of radiation

Radiation exposure can be expressed in certain units.

The *absorbed dose* is the amount of energy deposited per unit of mass. Most often this is measured in grays (Gy). A milligray (mGy), which is 1/1000th of a Gy, may also be used.

The *equivalent dose* is the absorbed dose multiplied by a converting factor based on the medical effects of the type of radiation. It is often expressed in sieverts (Sv) or millisieverts (mSv), which is 1/1000th of a Sv.

For x-rays and gamma rays (and beta particles), the equivalent dose in Sv is the same as the absorbed dose in Gy.

Less common radiation dose units include rads, rems, and roentgens.

Hyperlinks

1. www.cancer.org/cancer/cancer-causes/radiation-exposure/radon.html
2. www.cancer.org/cancer/cancer-causes/radiation-exposure/uv-radiation.html

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How are people exposed to x-rays and gamma rays?

People may be exposed to this type of radiation from 3 main sources:

- Natural background radiation comes from cosmic rays from our solar system and radioactive elements normally present in the soil. This is the major contributor to worldwide radiation exposure.
- [1]Medical radiation is used for x-rays, CT scans, and other tests, as well as for radiation therapy. Radiation therapy is used to treat some types of cancer and involves dosages many thousand times higher than those used in diagnostic x-rays.
- Non-medical, man-made radiation is used in small amounts in food irradiation, airport security scanners, and some consumer products. Exposure to man-made radiation can happen in certain workplaces, or in communities as a result of above ground nuclear weapons testing and nuclear accidents.

Hyperlinks

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Natural background radiation

We are all exposed to some amount of radiation just from being on this planet. This is known as *background radiation*. In the United States this averages about 3 mSv per year. For most people, background radiation accounts for most of their exposure to ionizing radiation during the year. It comes from several different sources.

Cosmic rays

Cosmic rays are radioactive particles that hit the earth from outer space. They come from the sun and from other stars. The earth's atmosphere blocks a portion of these rays, but some of them reach the ground.

Because the atmosphere blocks some cosmic rays, exposure is greater at higher altitudes. For example, people who live in Denver, Colorado, which is at a high elevation, are exposed to slightly more cosmic rays than people living at sea level. People are also exposed to higher levels of cosmic rays during airplane flights. Airline pilots and flight attendants, who spend many hours at high elevations, are exposed to more of these rays, but it is not clear if they have an increased risk of cancer because of it.

Radiation in the earth

People are also exposed to small amounts of radiation from radioactive elements that occur naturally in rocks and soil. Some of these may end up in building materials used in houses and other structures. Tiny amounts of radiation may even be found in drinking water and in some plant-based foods as a result of being in contact with the soil. For people who smoke, tobacco[1] can account for a significant portion of the yearly radiation they receive.

Radon

The largest source of natural background radiation for most people is radon. This is an odorless, colorless gas that is formed from the breakdown of radioactive elements in the ground. Radon levels are usually higher inside buildings and homes, especially in levels closer to the ground such as basements. Radon levels can vary a great deal, depending on where you live or work. For example, exposure is higher for people who work in mines. For more detailed information on radon and its possible health effects, see Radon[2].

Hyperlinks

1. www.cancer.org/cancer/cancer-causes/tobacco-and-cancer.html
2. www.cancer.org/cancer/cancer-causes/radiation-exposure/radon.html

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Medical radiation

X-rays, gamma rays, and other forms of ionizing radiation are used to diagnose and treat some medical conditions. This can be in the form of radiation that penetrates from outside the body, or radioactive particles that are swallowed or inserted into the body.

Imaging tests

Certain types of imaging tests, such as x-rays, CT scans, and nuclear medicine tests (such as PET scans and bone scans[1]) expose people to low levels of radiation in order to create internal pictures of the body. (Some imaging tests, such as MRI and ultrasound do not expose people to ionizing radiation.)

In adults: The amount of radiation varies depending on the test. For example, the exposure from a 2-view chest x-ray is about 0.1 mSv, while exposure from a regular chest CT is about 7 or 8 mSv. The exposure from a PET/CT scan (which combines a PET scan of the body with a CT scan) can be as high as 30 mSv. Fluoroscopy, which uses x-rays to make real-time moving images, is like getting many x-rays in a row. It exposes people to different amounts of radiation depending on how long it is used. The amount of radiation used in many imaging tests has gone down over time as technology has improved.

In children: Radiation exposure also varies based on the test. Unless the settings on the scanner are adjusted for body size, exposure levels can be higher than they would be for an adult. For example, one study found that an abdominal CT may expose an adult's stomach to about 10 mSv, while a newborn baby's stomach would be exposed to 20mSv by getting the same test without the settings adjusted.

For children, exposure to radiation from imaging tests is of particular concern, because:

- Children are much more sensitive to radiation than adults
- Children are expected to live longer than adults, so they have a longer time to develop problems from radiation exposure
- With tests like CT scans, children might receive a higher radiation dose than

necessary if the CT settings are not adjusted for their smaller body size

These factors mean that for a young child, the risk of developing a radiation-related cancer could be several times higher than for an adult exposed to the same imaging test. The risks from these tests are not known for sure, but to be safe, most doctors recommend that children only get these tests when they are absolutely needed. When such tests are done, it is important to use the minimum amount of radiation needed to get the image.

Radiation therapy

X-rays, gamma rays, and other forms of ionizing radiation offer an effective way to treat certain kinds of cancer. During radiation therapy[2], high doses of ionizing radiation (much higher than those used for imaging tests) are directed at the cancer, resulting in the death of the cancer cells. However, this can lead to DNA mutations in other cells that survive the radiation, which may eventually lead to the development of a second cancer. Radiation therapy is also sometimes used to treat serious medical conditions besides cancer.

For more information about cancer risks from radiation therapy for cancer, see Second Cancers in Adults[3].

Hyperlinks

1. www.cancer.org/treatment/understanding-your-diagnosis/tests/imaging-radiology-tests-for-cancer.html
2. /content/cancer/en/treatment/treatments-and-side-effects/treatment-types/radiation/science-behind-radiation-therapy.html
3. www.cancer.org/treatment/treatments-and-side-effects/physical-side-effects/second-cancers-in-adults.html

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Non-medical sources of man-made radiation

People may also be exposed to ionizing radiation from non-medical man-made sources.

Nuclear weapons

The atomic bombs dropped on Nagasaki and Hiroshima, Japan exposed many people to radiation from x-rays, gamma rays, and neutrons. Some people died fairly quickly as a result of burns and radiation sickness, but many survived. The survivors were exposed to different amounts of radiation, depending largely on how far they were from the explosions. Only about 2% of the survivors were exposed to high amounts of radiation (1000 mSv or more), while almost one-third were exposed to doses that are relatively low (less than 5 mSv). Much of the information that we have about radiation and cancer risks comes from studies of more than 105,000 of the survivors.

The United States government conducted above-ground nuclear tests in the South Pacific and in the state of Nevada between 1945 and 1962. Other countries also conducted above-ground tests. Many people in the military at the time were part of training exercises in the area and were exposed to ionizing radiation from these tests. Others were exposed to radiation while working at facilities making the bombs or at other nuclear sites.

Non-military people living near or downwind of nuclear test sites may have also been exposed to radioactive byproducts. Levels of radiation are likely to be higher near these sites, but some radioactive particles from the tests entered the atmosphere and traveled great distances, landing thousands of miles away from the original site. While exposure levels were likely to be higher at the time of testing, some radiation in the soil today is the result of these tests.

Programs have been set up to give financial support to people who were exposed to nuclear weapons testing and developed cancer. More information on this topic is available in *Cancer Compensation Programs for People Exposed to Radiation as a Part of Nuclear Weapons Testing*[1].

Nuclear power plants

Emissions of radiation from nuclear power plants are carefully monitored and controlled. According to the Environmental Protection Agency (EPA), nuclear power plant operations account for less than one-hundredth (1/100) of a percent of the average American’s total radiation exposure.

Nuclear power plant accidents: Accidents at nuclear power plants are rare, but they have the potential to expose people to high levels of radiation.

In 1986, an accident at the nuclear power plant at Chernobyl (in Ukraine) exposed millions of people living in the area to radiation, either directly or from radioactive elements released into the air that ended up deposited on the ground. The emergency clean-up workers were exposed to the highest levels of radiation. Although the average dose to clean-up workers was about 100 mSv, some were exposed to very high doses – more than 1000 mSv. The average doses to people living in the area (some of whom were evacuated) ranged from 10 to 50 mSv.

In 2011, an earthquake and tsunami struck the coast of Japan that resulted in damage to the Fukushima Dai-ichi Nuclear Power Plant in Fukushima Prefecture, Japan. Radiation was released into the air, contaminating soil, food, and water (both fresh and seawater). Within the plant, radiation levels reached as high as 10,000 mSv per hour early on. An area of more than 300 square miles around the plant was also found to be contaminated with radiation, although at lower levels than within the plant. Because of high radiation levels, many areas were evacuated. The health effects of this disaster are still being studied.

Workplace exposures

Some people can be exposed to radiation at work. For example:

- People who work in nuclear power plants may be exposed to higher levels of radiation than the general public, although their exposure levels are monitored carefully.
- People who work in uranium mines are monitored because of their exposure to radiation in the form of radon.
- People who work in health or dental care, particularly those who work with x-ray (or other imaging test) equipment or who work with radioactive isotopes, may also be exposed to radiation at work. Radiation exposure may also occur at some research labs.

In the United States, people who are likely to be exposed to radiation in the workplace are monitored carefully. Exposure is limited to an effective dose of 100 mSv over 5 years, with a maximum of 50 mSv in any single year.

Consumer products

Some consumer products contain small amounts of ionizing radiation.

For example, tobacco products contain low levels of radiation, which may come from the soil it’s grown in or the fertilizer used to help it grow. Tobacco may account for a significant portion of the yearly radiation that smokers are exposed to.

Some building materials used in the home or other structures may contain low levels of naturally occurring radiation. The amount of radiation can vary depending on what they’re made of, but the levels are unlikely to contribute much to a person’s overall exposure to radiation, according to the EPA.

Many smoke detectors contain a small amount of a very low-level radioactive material that helps detect the smoke. This material is sealed in a container and does not pose a significant risk of radiation exposure.

Food irradiation

Ionizing radiation can be used to kill bacteria and other germs on certain foods, which may make them safer to eat and help them last longer. Some people may be concerned that irradiated food may itself contain radiation.

It’s important to understand that the radiation does not stay in the food. According to the United States Department of Agriculture (USDA), irradiating food does *not* cause it to become radioactive and does not change nutritional value of the food any more than cooking or freezing it might.

Airport security scanners

In recent years, some airports have begun to use whole body scanners as a way to detect objects hidden by clothing. These scanners are different from the metal detectors most people are familiar with.

The type of body scanner currently in use is based on millimeter wave technology. Neither millimeter wave scanners nor metal detectors expose people to x-rays or gamma rays.

Another type of body scanner, based on backscatter technology, used very weak x-rays aimed at the surface of the body to capture a whole body image. These scanners are no longer in use.

Hyperlinks

1. /content/cancer/en/cancer/cancer-causes/radiation-exposure/cancer-among-military-personnel-exposed-to-nuclear-weapons.html

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Do x-rays and gamma rays cause cancer?

Yes. X-rays and gamma rays are known human carcinogens (cancer-causing agents). The evidence for this comes from many different sources, including studies of atomic bomb survivors in Japan, people exposed during the Chernobyl nuclear accident, people treated with high doses of radiation for cancer and other conditions, and people exposed to high levels of radiation at work, such as uranium miners.

Most studies on radiation and cancer risk have looked at people exposed to high doses of radiation in the settings above. It is harder to measure the much smaller increase in cancer risk that might come from much lower levels of radiation exposure. Most studies have not been able to detect an increased risk of cancer among people exposed to low levels of radiation. For example, people living at high altitudes, who are exposed to more natural background radiation from cosmic rays than people living at sea level, do not have noticeably higher cancer rates.

Still, most scientists and regulatory agencies agree that even small doses of gamma and x-radiation increase cancer risk, although by a very small amount. In general, the risk of cancer from radiation exposure increases as the dose of radiation increases. Likewise, the lower the exposure is, the smaller the increase in risk. But there is no threshold below which this kind of radiation is thought to be totally safe.

What do the studies show?

Atomic bomb survivors

Much of what we know about cancer risks from radiation is based on studies of the survivors of the atomic bombs in Nagasaki and Hiroshima. These people had higher risks of some, but not all cancers. Studies have found an increased risk of the following cancers (from higher to lower risk):

- Most types of leukemia (although not chronic lymphocytic leukemia)

- Multiple myeloma
- Thyroid cancer
- Bladder cancer
- Breast cancer
- Lung cancer
- Ovarian cancer
- Colon cancer (but not rectal cancer)
- Esophageal cancer
- Stomach cancer
- Liver cancer
- Lymphoma
- Skin cancer (besides melanoma)

For most of these cancers, the risk was highest for those exposed as children, and was lower as the age at exposure increased. Those exposed while still in the womb (in utero) had lower risks than those exposed during childhood.

Higher radiation exposure was linked to higher risk of cancer, but even low amounts of radiation were linked to an increased risk of getting and dying from cancer. There was no clear cut-off for safe radiation exposure.

These cancers took years to develop, but some cancers appeared sooner than others. Deaths from leukemia went up about 2 to 3 years after exposure, with the number of cases peaking after about 10 years and going down after that. Solid tumors took longer to develop. For example, excess deaths from lung cancer began to be seen about 20 years after exposure.

Chernobyl accident

Children and adolescents living near the Chernobyl plant at the time of the accident had an increased risk of thyroid cancer linked to exposure to radioactive iodine. The risk was higher in areas that were iodine deficient. This increased risk was not seen in adults living in the area.

Workers employed in cleanup operations from 1986-1990 had an increased risk of leukemia (all types). These individuals had higher and more prolonged radiation exposures that the population residing around the plant.

Nuclear weapons testing

Studies suggest that some people who were children during the period of above ground nuclear testing in the US may develop thyroid cancer as a result of exposure to radioactive iodine in milk.

Radiation therapy

To treat benign conditions

Although radiation therapy is now mostly used to treat cancer, it was used to treat a number of benign (non-cancerous) diseases before the risks were clearer. Studies of these patients have helped us learn about how radiation affects cancer risk.

Peptic ulcer disease: A large study of people who were treated with high doses of radiation (an average of 15 Gy or 15,000 mSv) for the treatment of peptic ulcers found a higher risk of cancer of the stomach and pancreas.

Ringworm of the scalp: Studies of people who were treated with radiation to treat a fungal infection of the scalp (called *scalp ringworm* or *tinea capitis*) have found an increased risk of basal cell skin cancers. The risk was lower in people who were older when treated. This increased risk was seen only in white patients, and the cancers occurred more often in sun-exposed skin of the head and neck (as opposed to the scalp), which implies that ultraviolet (UV) radiation plays a role in these cancers as well.

Ankylosing spondylitis: Studies have looked at the cancer risks of patients with the autoimmune disease ankylosing spondylitis who were injected with a form of radium.

In one study, patients who received a high dose (average bone dose of 31,000 mGy) had an increased risk of bone sarcoma. The risks of some other cancers, such as breast, liver, kidney, bladder, and other sarcomas, may also have been increased. About one-quarter of the patients in this study were younger than 20 years of age when they were treated with radiation.

In another study, patients treated with a lower dose of radium (average bone dose of 6,000 mGy) had a higher risk of leukemia, but not of any other cancers. Most of the patients in this study were adults at the time of treatment.

Other studies: Treatment of the head and neck area with radiation for benign conditions has also been linked to cancers of the salivary gland and brain and spinal cord in adults in some studies. Children treated with radiation to this area also have an increased risk of thyroid cancer.

To treat cancer

Studies have linked radiation therapy to treat cancer with an increased risk of leukemia, thyroid cancer, early-onset breast cancer, and some other cancers. The risk of cancer depends on a number of factors, include the dose of radiation, the part of the body being treated, the age of the person getting it (younger people are generally at greater risk), and the use of other treatments such as chemotherapy.

For example, people who get pelvic radiation therapy would not be expected to have higher rates of cancers in the head and neck because these areas weren't exposed to the radiation from the treatment. Other factors might also play a role in how likely a person exposed to radiation is to develop cancer. For example, some genetic conditions can mean that a person's cells are more vulnerable to radiation damage, which might in turn raise their risk more than in someone without these gene changes.

If cancer does develop after radiation therapy, it does not happen right away. For leukemias, most cases develop within 5 to 9 years after exposure. In contrast, other cancers often take much longer to develop. Most of these cancers are not seen for at least 10 years after radiation therapy, and some are diagnosed even more than 15 years later.

When considering radiation exposure from radiation therapy treatment for cancer, the benefits generally outweigh the risks. Overall, radiation therapy alone does not appear to be a very strong cause of second cancers. This is probably due to the fact that doctors try to focus the radiation on the cancer cells as much as possible, which means few normal cells are exposed to radiation. However, some combinations of radiation therapy and chemotherapy are more risky than others. Doctors do their best to ensure the treatment that is given destroys the cancer while limiting the risk that a secondary cancer will develop later on.

For more information, see Second Cancers in Adults[1].

Imaging tests

Some studies have estimated the risk of radiation exposure from imaging tests based on the risks from similar amounts of radiation exposure in the studies of the atomic bomb survivors. Based on these studies, the US Food and Drug Administration (FDA) estimates that exposure to 10 mSv from an imaging test would be expected to increase the risk of death from cancer by about 1 chance in 2000.

It can be difficult to study cancer risks from imaging studies that use radiation. In order to see small risks (such as 1 in 2000), a study would have to look at 10s or 100s of thousands of people. Information about other exposures that could be cancer risk factors would be needed, to see if it was likely that the cancer came from the radiation exposure. Since cancers from radiation take years to develop, the study would need to follow the patients for many years.

Often, scientists use questionnaire studies to look for possible causes of cancer. These studies compare exposures among people who have a certain cancer to those who don't. They may instead compare people who had a certain exposure (like to radiation) to those who didn't. However, this is difficult to do for diagnostic radiation exposure since many people cannot accurately recall information about things that happened many years before (such as in childhood) and information about all the imaging tests that were done is often not available. There is also a concern that people with cancer tend to over report exposures that they worry may have caused their cancers.

Studies that have found increased risk of cancer after imaging tests that use x-rays often involve people who had multiple tests or high dose procedures, including:

Fluoroscopy

Studies of women who had been imaged many times with fluoroscopy as a teenager or young woman during treatment for tuberculosis have found an increased risk of breast cancer years later.

Spine x-rays

Teenagers and young women who had many x-rays of the spine to monitor scoliosis have been found to have an increased risk of breast cancer later on.

Dental x-rays

A study compared a group of people with meningioma (a brain tumor that is most often benign) with a group without the tumors. It found that the people who had the tumors were more likely to have had a type of dental x-ray called a bite-wing, and to have had bite-wing or Panorex x-rays every year.

CT scans

A study in England of exposure to radiation from CT scans found that children who received a dose of at least 30 mGy (the same as 30 mSv) to the bone marrow had 3 times the risk of leukemia compared to those who received a dose of 5 mGy or less. For brain tumors, a dose of 50 mGy or more to the brain was linked to more than 3 times the risk.

A study in Australia of exposure to radiation from CT scans in childhood and adolescence found that after an average of about 9 ½ years, those who had a CT scan had a 24% higher risk of cancer overall. The risk of cancer was higher the more CT scans the person had, and it was also higher the younger the person was at the time of the CT scan. Still, the overall risk of cancer was still low.

A study from Taiwan found that children and teens who had a CT scan of the head did not have a higher risk of brain cancer or leukemia, but were more likely to be diagnosed with a benign brain tumor.

What do expert agencies say?

Several agencies (national and international) study different substances in the environment to determine if they can cause cancer. (A substance that causes cancer or helps cancer grow is called a *carcinogen*.) The American Cancer Society looks to these organizations to evaluate the risks based on evidence from laboratory, animal, and human research studies.

Based on animal and human evidence, several expert agencies have evaluated the cancer-causing nature of x-rays and gamma rays.

The **International Agency for Research on Cancer (IARC)** is part of the World Health Organization (WHO). Its major goal is to identify causes of cancer. Based on the data available, IARC classifies x- and gamma radiation as a “known human carcinogen.”

The **National Toxicology Program (NTP)** is formed from parts of several different US government agencies, including the National Institutes of Health (NIH), the Centers for Disease Control and Prevention (CDC), and the Food and Drug Administration (FDA). The NTP has classified x- and gamma radiation as “known to be a human carcinogen.”

The US **Environmental Protection Agency (EPA)** sets limits for exposure to x-rays and gamma rays in part because it recognizes that this form of radiation can cause cancer.

For more information on the classification systems used by these agencies, see Known and Probable Human Carcinogens[2].

Hyperlinks

1. www.cancer.org/treatment/treatments-and-side-effects/physical-side-effects/second-cancers-in-adults.html
2. www.cancer.org/cancer/cancer-causes/general-info/known-and-probable-human-

carcinogens.html

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Do x-rays and gamma rays cause any other health problems?

X-rays and gamma rays can cause a number of other problems besides cancer. What problems occur depend upon the radiation dose, the timing of the exposure, and what areas of the body are exposed.

Exposure to high doses of radiation over a short period of time can cause radiation sickness (sometimes called radiation poisoning or acute radiation syndrome) and even death. Some of the symptoms of radiation sickness include fainting, confusion, nausea and vomiting, diarrhea, hair loss, skin and mouth sores, and bleeding. The atomic bomb blasts in Hiroshima and Nagasaki led to many cases of radiation sickness. Since then, some cases have resulted from nuclear power plant accidents, such as those in Chernobyl and in Fukushima.

Doses of radiation such as those given in radiation therapy also cause side effects. Short-term side effects depend on the area being treated but often include skin changes (ranging from mild reddening to something like a severe burn), nausea, vomiting, diarrhea, and low blood cell counts. There is also a risk of long-term side effects, which again vary depending on the area being treated. For example, radiation to the head and neck area can lead to problems with dry mouth and trouble swallowing. Radiation can weaken bones, so that they are more likely to break later on. Radiation to the bone marrow can lead to long-term problems with blood cell counts and even a disease called *aplastic anemia*. Radiation can also lead to infertility (problems getting pregnant or fathering children)

Lower doses of radiation, such as from imaging tests are not known to cause short-term health problems.

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Can I avoid exposure to radiation from x-rays and gamma rays?

Not entirely. Just living on this planet exposes you to some radiation. You can, however, limit your exposure to some sources of radiation, such as x-rays from imaging tests, radiation in the workplace, and radon in your home.

Radiation from imaging tests

In recent years, the average amount of radiation a person is exposed to from medical tests has risen. This is of particular concern for children, because their growing bodies are especially sensitive to radiation.

The increased risk of cancer from exposure to any single test is likely to be very small. But radiation exposure from all sources can add up over one's lifetime, so imaging tests that use radiation should only be done if there is a good medical reason to do so. The usefulness of the test must always be balanced against the possible risks from exposure to the radiation. In some cases, other imaging tests that don't use radiation such as ultrasound or MRI may be an option. But if there is a reason to believe that an x-ray or CT scan is the best way to look for cancer or other diseases, the patient will most likely be helped more than the small dose of radiation can hurt.

If you do need to have a test that will expose you to some radiation, ask if there are ways to shield the parts of your body that aren't being imaged from being exposed. For example, a lead apron can sometimes be used to protect parts of your chest or abdomen from getting radiation, and a lead collar (known as a thyroid shield or thyroid collar) can be used to protect your thyroid gland.

According to the Environmental Protection Agency, "The best way to protect yourself from excessive radiation from x-rays is to make sure the technician performing the procedure has the proper qualifications, and to simply ask questions. You might inquire about the necessity of having an x-ray, or receive assurance the x-ray machine has been inspected recently and that it is properly calibrated. You should be aware of steps taken to prevent exposures to other parts of your body (for example, through the use of a lead apron)."

For children

The Alliance for Radiation Safety in Pediatric Imaging (also called the Image Gently

Alliance) recommends that parents ask questions before their children have tests such as a CT scan to make sure that the facility adjusts the radiation doses for children. They also recommend asking if the facility is accredited in CT by the American College of Radiology.

Also, based on one study, your child may be exposed to less radiation if the scan is done at a children's hospital.

For more detailed information about radiation doses from imaging tests in adults, see Imaging (Radiology) Tests[1].

Radiation in the workplace

In the US, a number of federal agencies are charged with protecting workers from radiation exposure, including the Occupational Safety and Health Administration (OSHA), the Nuclear Regulatory Commission, and the Department of Energy. Each agency is responsible for a different set of workplaces, but all follow the same general principles. If you work someplace where radiation exposure is likely, your employer can tell you which agency sets the standards for your workplace.

In general, employers cannot allow employees to be exposed to levels of radiation over a certain (low) limit without informing them of the risks. They also must take steps to monitor the level of exposure and make sure that the exposure stays below certain limits. Workers can do their part by learning about the risks and following safety procedures, which may include using protective clothing and equipment.

Radon

For most people, the largest potential source of radon exposure is in the home. You can check radon levels in your home, either with do-it-yourself kits or by hiring a professional. If the levels are high, there are steps you can take to try to lower them.

For more information, see Radon[2].

Hyperlinks

1. www.cancer.org/treatment/understanding-your-diagnosis/tests/imaging-radiology-tests-for-cancer.html
2. www.cancer.org/cancer/cancer-causes/radiation-exposure/radon.html

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Additional resources

Other organizations and websites*

In addition to the American Cancer Society, other sources of information and support include:

Centers for Disease Control and Prevention (CDC) Toll-free number: 1-800-232-4636 (1-800-CDC-INFO) Website: www.cdc.gov[1] Information about radiation and health: www.cdc.gov/nceh/radiation/default.htm[2]

Environmental Protection Agency (EPA) Website: www.epa.gov[3] Understanding Radiation: www.epa.gov/radiation/understanding-radiation-overview.html[4]

Food and Drug Administration (FDA) Website: www.fda.gov[5] Information about radiation emitting products (including imaging tests): www.fda.gov/Radiation-EmittingProducts/default.htm[6]

Image Gently: The Alliance for Radiation Safety in Pediatric Imaging Website: www.imagegently.org[7] Information for parents: imagegentlyparents.org[8]

National Cancer Institute (NCI) Toll-free number: 1-800-422-6237 (1-800-4-CANCER) Website: www.cancer.gov[9]

National Institute of Environmental Health Sciences Website: www.niehs.nih.gov[10]

**Inclusion on this list does not imply endorsement by the American Cancer Society.*

No matter who you are, we can help. Contact us anytime, day or night, for information and support. Call us at **1-800-227-2345** or visit www.cancer.org.

Hyperlinks

1. http://www.cdc.gov/
2. http://www.cdc.gov/nceh/radiation/default.htm
3. www.epa.gov/
4. www.epa.gov/radiation/understanding-radiation-overview.html
5. http://www.fda.gov/
6. http://www.fda.gov/Radiation-EmittingProducts/default.htm
7. www.imagegently.org/

8. http://imagegentlyparents.org/
9. http://www.cancer.gov/
10. http://www.niehs.nih.gov/

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